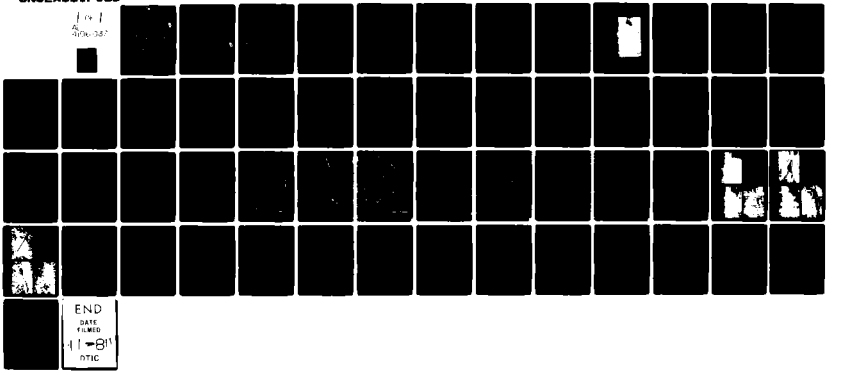
AD-A106 037 HORNER AND SHIFRIN INC ST LOUIS MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. DEHNER LAKE DAM (MO 30423), UPPER --ETC(U)
APR 81 R E SAUTHOFF, A B BECKER DACW43-81-C-0002
UNCLASSIFIED NL



END
DATE FILMED
11-81
DTIC

LEVEL II

UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

AD A106037

DEHNER LAKE DAM

JEFFERSON COUNTY, MISSOURI

MO 30423

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

Original contains color plates: All DTIC reproductions will be in black and white

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

APRIL 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO. AD-A106

3. RECIPIENT'S CATALOG NUMBER 037

4. TITLE (and Subtitle)
Phase I Dam Inspection Report
National Dam Safety Program
Dehner Lake Dam (MO 30423)
Jefferson County, Missouri

5. TYPE OF REPORT & PERIOD COVERED
Final Report

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Horner & Shifrin, Inc.

8. CONTRACT OR GRANT NUMBER(s)
DACW43-81-C-0002

9. PERFORMING ORGANIZATION NAME AND ADDRESS
U.S. Army Engineer District, St. Louis
Dam Inventory and Inspection Section, LMSED-PD
210 Tucker Blvd., North, St. Louis, Mo. 63101

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
U.S. Army Engineer District, St. Louis
Dam Inventory and Inspection Section, LMSED-PD
210 Tucker Blvd., North, St. Louis, Mo. 63101

12. REPORT DATE
April 1981

13. NUMBER OF PAGES
Approximately 40

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES
National Dam Safety Program. Dehner Lake Dam (MO 30423), Upper Mississippi - Kaskaskia - St. Louis Basin, Jefferson County, Missouri. Phase I Inspection Report.

DTIC ELECTE OCT 21 1981 D H

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

41 555

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

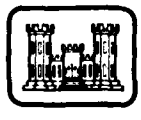
UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

DEHNER LAKE DAM

JEFFERSON COUNTY, MISSOURI

MO 30423

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

APRIL 1981

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

LMSED-P

SUBJECT: Dehner Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Dehner Lake Dam (MO 30423):

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

2) Overtopping of the dam could result in failure of the dam.

3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 11 MAY 1981
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 12 MAY 1981
Colonel, CE, District Engineer — Date

DEHNER LAKE DAM

MISSOURI INVENTORY NO. 30423

JEFFERSON COUNTY, MISSOURI

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.
5200 OAKLAND AVENUE
ST. LOUIS, MISSOURI 63110

FOR:

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

APRIL 1981

HS-8088

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Dehner Lake Dam
State Located:	Missouri
County Located:	Jefferson
Stream:	Sub-tributary of Sandy Creek
Date of Inspection:	20 November 1980

The Dehner Lake Dam, which according to the St. Louis District, Corps of Engineers, is of high hazard potential, was visually inspected by engineering personnel of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of this inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses an inordinate danger to human life or property. Evaluation of this dam was performed in accordance with the "Phase I" investigation procedures prescribed in "Recommended Guidelines for Safety Inspection of Dams", dated May 1975.

The following summarizes the findings of the visual inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team. Based on the visual inspection and the results of the hydrologic/hydraulic investigations, the present general condition of the dam is considered to be less than satisfactory. Several items were noticed during the inspection which are considered to have an adverse effect on the overall safety and future operation of the dam. These items include trees and undergrowth on both the upstream and downstream faces of the dam, animal burrows, the lack of adequate slope protection to prevent erosion of the upstream face of the dam, and seepage at the toe of the embankment in the original valley fill.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Dehner Lake Dam, which, according to Table 1 of the guidelines, is classified as small in size and of

high hazard potential, is specified, according to Table 3 of the guidelines for a dam of high hazard potential and small size, to be a minimum of one-half the Probable Maximum Flood (PMF). The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Considering the fact that a relatively small volume of water is impounded by the dam, that the downstream flood plain is fairly broad, and that there are but six dwellings within the potential flood damage zone, it is recommended that the spillway for this dam be designed for one-half the PMF.

Results of a hydrologic/hydraulic analysis indicated that the spillway is inadequate to pass lake outflow resulting from a storm of one-half PMF magnitude without overtopping the dam. The spillway is capable of passing lake outflow corresponding to about 45 percent of the PMF lake inflow and the lake outflow resulting from the 1 percent chance (100-year frequency) flood. According to the St. Louis District, Corps of Engineers, the length of the downstream damage zone, should failure of the dam occur, is estimated to be two miles. Within the possible damage zone are six dwellings, including two mobile homes, two barns, State Highway 21, and a covered bridge at the Lemay Ferry Road crossing of the stream.

A review of available data did not disclose that seepage or stability analyses of the dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the Owner take the necessary action within the near future to correct or control the deficiencies and safety defects reported herein.

Ralph E. Sauthoff
P. E. Missouri E-19090

Albert B. Becker, Jr.
P. E. Missouri E-9168

OVERVIEW DEHNER LAKE DAM

PHASE 1 INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

DEHNER LAKE DAM - MO 30423

TABLE OF CONTENTS

LIST OF PLATES

APPENDIX A - INSPECTION PHOTOGRAPHS

APPENDIX B - HYDROLOGIC AND HYDRAULIC ANALYSES

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

DEHNER LAKE DAM - MO 30423

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, dated 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, directed that a safety inspection of the Dehner Lake Dam be made.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general condition of the dam with respect to safety and, based upon available data and this inspection, determine if the dam poses an inordinate danger to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in the "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report to the Chief of Engineers on the National Program of Inspection of Non-Federal Dams", dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Dehner Lake Dam is an earthfill type embankment rising approximately 29 feet above the natural streambed at the downstream toe of the barrier. At the surveyed cross-section, the embankment has an upstream slope (above the normal waterline) of approximately 1v on 2.3h, a crest width of about 13 feet, and an irregular downstream slope on the order of 1v on 2.4h between the crest and about the mid-height of the dam that becomes slightly steeper, approximately 1v on 2.0h, below the mid-height of the dam. The length of the dam is

approximately 496 feet. The longitudinal alignment of the dam is somewhat irregular between abutments with the center one-half, or so, of the structure projecting lakeward with respect to the abutments. A plan and profile of the dam is shown on Plate 3 and a cross-section of the dam, at about the location of the original stream on which the dam was constructed, is shown on Plate 4. At normal pool elevation, the reservoir impounded by the dam occupies approximately 3.5 acres. There is no lake drawdown facility to dewater the lake. An overview photo of the Dehner Lake Dam is shown following the preface at the beginning of the report.

The spillway for the dam, an excavated earth trapezoidal section, is located at the right, or south, abutment. Just downstream of the crest section, the spillway channel is protected for a distance of perhaps 10 feet by pieces of broken concrete. The spillway outlet channel, an irregular trapezoidal section, appears to join a natural drainage course at a point about 75 feet downstream of the spillway crest. This natural drainage course, or draw, proceeds down the hillside to the valley floor joining the original stream on which the dam was constructed at a point approximately 150 feet downstream of the toe of the dam, and just upstream of an 18-inch diameter pipe culvert which serves to carry the flow beneath Dehner Road. A profile of the spillway channel and a cross-section of the channel at the location of the crest, is shown on Plate 4.

b. Location. The dam is located on an unnamed sub-tributary of Sandy Creek about 1.0 mile northwest of the instersection of Glade Chapel Road and State Highway 21; about 5.0 miles north of the City of Hillsboro, Missouri, as shown on the Regional Vicinity Map, Plate 1. The dam is located within the northwest one-quarter of Section 11 of Township 41 North, Range 4 East, in Jefferson County.

c. Size Classification. The size classification based on the height of the dam and storage capacity, is categorized as small (per Table 1, Recommended Guidelines for Safety Inspection of Dams). A small size dam is classified, according to the guidelines, as having a height less than 40 feet, but greater than or equal to 25 feet and/or a storage capacity less than 1,000 acre-feet, but greater than or equal to 50 acre-feet.

d. Hazard Classification. The Dehner Lake Dam, according to the St. Louis District, Corps of Engineers, has a high hazard potential, meaning that if the dam should fail, there may be loss of life, serious damage to homes, or extensive damage to agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends two miles downstream of the dam. Within the possible damage zone are six dwellings, including two mobile homes, two barns, State Highway 21, and a covered bridge at the Lemay Ferry Road crossing of the stream. Those features lying within the downstream damage zone as reported by the St. Louis District, Corps of Engineers, were verified by the inspection team.

e. Ownership. The lake and dam are owned by Silvia Dehner. Mrs. Dehner's address is: 203 Vida, St. Louis County, Missouri 63125.

f. Purpose of Dam. The dam impounds water for recreational use.

g. Design and Construction History. According to the Owner's son, Frank Dehner, Jr. (Mr. Dehner served as spokesman for his mother during the course of these investigations), the dam was constructed in 1958 by the Samuel Kraus Construction Company, a general contractor of St. Louis, Missouri. No additional information relating to the design or construction of the dam was available.

h. Normal Operational Procedure. The lake level is unregulated. Lake outflow is governed by the capacity of an excavated earth type spillway.

1.3 PERTINENT DATA

a. Drainage Area. The area tributary to the lake is about one-third meadowland and two-thirds woodland. The watershed above the dam amounts to approximately 79 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

1. Estimated known maximum flood at damsite ... 35 cfs* (W.S. Elev. 574.0)
2. Spillway capacity ... 432 cfs (W.S. Elev. 576.4)

c. Elevation (Ft. above MSL). Except where noted, the following elevations were determined by survey and are based on topographic data shown on the 1954 U.S.G.S. Belew Creek, Missouri, Quadrangle Map, 7.5 Minute Series, photorevised 1968 and 1974.

1. Observed pool ... 572.1
2. Normal pool ... 573.0
3. Spillway crest ... 573.0
4. Maximum experienced pool ... 574.0*
5. Top of dam ... 576.4 (Min.)
6. Streambed at centerline of dam ... 550± (Est.)
7. Maximum tailwater ... Unknown
8. Observed tailwater ... None

d. Reservoir.

1. Length at normal pool (Elev. 573.0) ... 570 ft.
2. Length of pool at top of dam (Elev. 576.4) ... 650 ft.

e. Storage.

1. Normal pool ... 27 ac. ft.
2. Top of dam (incremental) ... 15 ac. ft.

f. Reservoir Surface Area.

1. Normal pool ... 3.5 acres
2. Top of dam (incremental) ... 2.0 acres

*Based on an estimate of maximum depth of flow at spillway, per Frank Dehner, Jr.

g. Dam. The height of the dam is defined to be the overall vertical distance from the lowest point of foundation surface at the downstream toe of the barrier, to the top of the dam.

1. Type ... Earthfill
2. Length ... 496 ft.
3. Height ... 29 ft.
4. Top width ... 13 ft.
5. Side slopes
   a. Upstream ... 1v on 2.3h (above normal waterline)
   b. Downstream ... 1v on 2.4h to 1v on 2.0h (irregular)
6. Cutoff ... Unknown
7. Slope protection
   a. Upstream ... Grass
   b. Downstream ... Grass

h. Principal Spillway.

1. Type ... Uncontrolled, excavated earth, trapezoidal section
2. Location ... Right abutment
3. Crest ... Elevation 573.0
4. Width ... 8 ft.
5. Side slopes ... Varies
6. Approach channel ... Lake
7. Outlet channel ... Irregular earth and bedrock, trapezoidal section

i. Emergency Spillway ... None

j. Lake Drawdown Facility ... None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No data relating to the design of the dam are known to exist.

2.2 CONSTRUCTION

As previously indicated, the dam was constructed in 1958 by the Samual Kraus Construction Company of St. Louis, Missouri. According to Samual Kraus, Jr. (Mr. Kraus, Sr. is deceased), the material to build the dam was obtained from the site and most likely from the area to be occupied by the lake. No other information regarding construction of the dam was available.

2.3 OPERATION

The lake level is uncontrolled and governed by the elevation of the crest of the excavated earth spillway. There is no lake drawdown facility. No indication was found that the dam has been overtopped. According to Mr. Dehner, Jr., the dam has never been overtopped. Mr. Dehner, Jr. reported that, to the best of his knowledge, the highest lake level observed produced a depth of flow at the spillway estimated to be on the order of 12 inches.

2.4 EVALUATION

a. Availability. Engineering data for assessing the design of the dam and spillway were unavailable.

b. Adequacy. No data available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Dehner Lake Dam was made by Horner & Shifrin engineering personnel, R. E. Sauthoff, Civil Engineer, H. B. Lockett, Hydrologist, and A. B. Becker, Jr., Civil and Soils Engineer, on 20 November 1980. Neither the Owner or a representative of the Owner was present during the inspection. An examination of the dam site was also made by an engineering geologist, Jerry D. Higgins, Ph.D., a consultant retained by Horner & Shifrin for the purpose of assessing the area geology. Also examined at the time of the inspection were the areas and features below the dam within the potential flood damage zone. Photographs of the dam taken at the time of the inspection are included on pages A-1 through A-3 of Appendix A. The locations of the photographs taken during the inspection are indicated on Plate 3.

b. Site Geology. Dehner Lake is located on a southeastward-flowing subtributary of Sandy Creek. The topography around the lake site is moderately sloping, with the relief between the lake and the surrounding drainage divides ranging up to approximately 200 feet. The area is included within the northeastern part of the Ozark Plateaus Physiographic Province.

The bedrock consists of Ordovician-age sedimentary strata of the Jefferson City-Cotter and St. Peter formations. The regional dip is to the northeast. The dam and reservoir are located on the Jefferson City-Cotter formation, with the basal St. Peter outcropping a few feet above water level in the left abutment. The Jefferson City-Cotter is exposed in the spillway channel. No faulting was observed or reported in the vicinity of the dam site.

The Jefferson City-Cotter formation is a light brown to gray, medium to finely crystalline dolomite. It is generally thin- to medium-bedded and contains both nodular and bedded chert, as well as some thin sandstone layers. Solution weathering of the carbonate bedrock commonly causes open joints and bedding planes, and the contact between bedrock and the overlying soils is generally very irregular as a result of the solution weathering.

These weathering features are commonly the cause of reservoir leakage when the soil cover is thin. The St. Peter formation is a white, fine- to medium-grained, pure quartz sandstone. It is massively bedded and, although loosely cemented, exposed rock surfaces are generally case-hardened by weathering processes. Weathered exposures in the left abutment are red-brown in color and friable.

The soils at the site are composed primarily of tan clays (CL, Unified Soil Classification System) derived from the in-place weathering of dolomite bedrock. Near sandstone outcrops, the soils are somewhat sandy. These soils do not appear to be especially susceptible to erosion or seepage and are generally suited for construction of small embankments.

The most significant geologic condition noted at the site is the permeable bedrock. However, it appears the soils are of sufficient thickness and low enough permeability to avoid excessive water loss. No other geologic conditions were observed that would be expected to adversely affect the performance of the dam embankment or reservoir.

c. Dam. The visible portions of the upstream and downstream faces of the dam, as well as the dam crest (see Photos 1, 2 and 3), were examined and, except as noted herein, found to be in sound condition. No cracking of the surface, sliding or sloughing of the slopes, or significant erosion of the structure was noted. Some minor erosion that appeared to be due to wave action or fluctuations of the lake level had created a near vertical bank approximately 8 inches high at the normal waterline along a portion of the unprotected (no riprap) upstream face of the dam. Numerous trees up to 18 inches in diameter and areas of undergrowth up to 3 feet high were found on both the upstream and downstream faces of the dam. However, the crest of the dam was clear of trees and had a good cover of turf consisting of a combination of fescue grass and weeds that were about 6 inches high at the time of the inspection. However, the dam crest was somewhat undulating across the width of the section and in several places, abrupt dips of up to 12 inches in depth were noted. The remnants of what appeared to be an old muskrat den was noticed in the upstream face of the dam at about station 1+27. Several holes that appeared to be groundhog dens, one at about station 2+43 (see Photo

7) approximately 7 feet below the top of the dam, and two at about station 3+68 (see Photo 8) near the mid-height of the dam were observed in the downstream face of the dam.

A wet area (see Photo 9), approximately 20 feet wide and 30 feet long, believed to be due to lake seepage was observed in the original valley fill near the toe of the dam opposite about station 2+10. Flow from the area was not observed, and the rate of seepage could not be determined.

According to survey data obtained during the inspection, it is likely that the dam has experienced some settlement, perhaps as much as 1.0 foot at the location of the original stream crossing. Examination of a soil sample obtained from the downstream face of the embankment near the center of the dam indicated the surficial material to be a tan, somewhat sandy lean clay (CL) of low-to-medium plasticity.

The excavated earth spillway (see Photos 4 and 5) was inspected and found to be in reasonably good condition, although some minor erosion of the spillway channel was evident through the area of the channel protected by pieces of broken concrete. Downstream of the crest (see Photo 6), the spillway channel was eroded to bedrock, but it did not appear that the erosion threatens the dam.

d. Appurtenant Structures. No appurtenant structures were observed at this dam site.

e. Downstream Channel. Except at roadway crossings, the channel downstream of the dam within the potential flood damage zone is unimproved. The channel section is irregular and for the most part, lined with trees. The stream joins Sandy Creek at a point about 1 mile downstream of the dam, just west of State Highway 21.

f. Reservoir. Except for a relatively small area near the right abutment and the area adjacent to the north side of the lake, the area surrounding the reservoir is covered with trees and in a natural condition. No significant erosion of the lake banks at the shoreline was noticed. At the

time of the inspection, the lake water was clear and the level was about 0.9 foot below normal pool. It was not feasible to determine the amount of sediment within the reservoir during the inspection. However, due to the fact that the drainage area is well covered with vegetation and since no erosion of the lake banks was noticed, the amount of sediment within the reservoir is not expected to be significant.

3.2 EVALUATION

The deficiencies observed during this inspection and noted herein are not considered of significant importance to warrant immediate remedial action. However, it is recommended that, as soon as practical, the Owner rid the dam of burrowing animals and that the embankment be restored at the locations of these animal burrows, since voids in the dam can provide passageways for lake seepage that could result in a piping condition that can lead to failure of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled. The lake surface level is governed by precipitation runoff, evaporation, seepage, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

According to Mr. Dehner, Jr., the grass on the dam crest is cut periodically during the growing season and, with this exception, no other routine maintenance of the dam is performed.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

No outlet facilities requiring operation exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection did not reveal the existence of a dam failure warning system.

4.5 EVALUATION

It is recommended that maintenance of the dam include such items as the removal of trees and brush and the periodic cutting of grass on the dam slopes as well as the crest. In addition, the owner should without delay take whatever measures are necessary to rid the dam of burrowing animals and to restore the embankment to sound condition. It is also recommended that a detailed inspection of the dam be instituted on a regular basis by an engineer experienced in the design and construction of dams and that records be kept of all inspections made and remedial measures taken.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data were not available.

b. Experience Data. The drainage area and lake surface area were determined from the 1954 USGS Belew Creek, Missouri, Quadrangle Map (photorevised 1968 and 1974). The proportions and dimensions of the spillway and dam were developed from surveys made during the inspection. Records of rainfall, streamflow, or flood data for the watershed were not available.

Due to the fact that the watershed for this reservoir is small and since there is no history of excessive reservoir leakage that would adversely affect the normal operational level of the lake, the lake level was assumed to be at normal pool as a result of antecedent storms prior to occurrence of the probable maximum flood and the probabilistic storm.

According to the St. Louis District, Corps of Engineers, the estimated flood damage zone, should failure of the dam occur, extends two miles downstream of the dam.

c. Visual Observations.

(1) The spillway, an excavated earth trapezoidal section, is located at the right, or south, abutment.

(2) The spillway outlet channel joins the original stream channel at a point approximately 150 feet downstream of the toe of the dam.

(3) Due to the fact that the spillway outlet directs flow away from the dam, lake outflow within the capacity of the spillway outlet should not endanger the dam.

(4) There is no lake drawdown facility.

(5) A small pond approximately 0.3 acre in size lies within the watershed upstream of the lake. The pond was considered to be hydrologically insignificant so far as the investigations contained herein are concerned.

d. Overtopping Potential. The spillway is inadequate to pass the probable maximum flood, or 1/2 the probable maximum flood, without overtopping the dam. The spillway is adequate, however, to pass the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of the dam overtopping analyses are as follows:

(Note: The data appearing in the following table were extracted from the computer output data appearing in Appendix B. Decimal values have been rounded to the nearest one-tenth in order to prevent assumption of unwarranted accuracy.)

Ratio of PMF	Q-Peak Outflow (cfs)	Max. Lake W.S. Elev.	Max. Depth (Ft.) of Flow over Dam (Elev. 576.4)	Duration of Overtopping of Dam (Hours)
0.50	529	576.6	0.2	0.3
1.00	1,850	577.6	1.2	0.7
1% Chance Flood	235	575.1	0.0	0.0

Elevation 576.4 was found to be the lowest point in the dam crest. The flow safely passing the spillway just prior to dam overtopping was determined to be approximately 432 cfs, which is the routed outflow corresponding to about 45 percent of the probable maximum flood inflow. This flow is greater than the outflow from the 1 percent chance (100-year frequency) flood. During peak flow of the probable maximum flood, the greatest depth of the flow over the dam is projected to be 1.2 feet and overtopping will extend across almost the entire length of the dam. During peak flow of the one-half probable maximum flood, which is the recommended spillway design flood for this dam, the greatest depth of flow over the dam is projected to be 0.2 feet and overtopping will extend across an area about 60 feet long adjacent to the spillway, and an area about 100 feet long between stations 1+75 and 2+65.

e. Evaluation. The results of the overtopping analysis indicate the existing spillway is inadequate to pass the lake outflow resulting from the probable maximum flood or from one-half the probable maximum flood, which is the recommended spillway design flood. With regard to these flood events, the following evaluation of dam overtopping is offered:

Experience with embankments constructed of similar material (a sandy lean clay of low-to-medium plasticity) to that used to construct this dam has shown evidence that under certain conditions, such as high velocity flow, the material can be very erodible. Such a condition exists during the PMF when large lake outflow, accompanied by high flow velocities, occurs. For the PMF condition where the depth of the flow over the dam crest, a maximum of 1.2 feet, and the duration of flow over the dam, 0.7 hours, are significant, damage by erosion to the crest and downstream face of the dam is expected. The extent of these damages is not predictable within the scope of this investigation; however, there is a possibility that they could result in failure by erosion of the dam. For the one-half PMF condition, where the depth of flow over the dam, a maximum of 0.2 foot, and the duration of flow over the dam, 0.3 hours, are both quite small, serious damage, such as failure of the dam by erosion, is unlikely; however, it is possibility.

f. References. Procedures and data for determining the probable maximum flood, the 100-year flood, and the discharge rating curve for flow passing the spillway and dam crest are presented on pages B-1 and B-2 of Appendix B. Listings of the HEC-1 (Dam Safety Version) input data for both the probable maximum flood, and the probabilistic flood, are shown on pages B-3 through B-5. Computer output data, including unit hydrograph ordinates, tabulation of PMF rainfall, loss and inflow data are shown on pages B-6 through B-9; tabulation of lake surface area, elevation and storage volume is shown on page B-10; tabulations titled "Summary of Dam Safety Analysis" for the PMF and the 1 percent chance (100-year frequency) flood are also shown on page B-10 of Appendix B.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which adversely affect the strucutral stability of the dam are discussed in Section 3, paragraph 3.1c.

b. Design and Construction Data. No design or construction data relating to the structural stability of the dam are known to exist. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to Mr. Dehner, Jr., no records of lake level, spillway discharge, dam settlement, or lake seepage have been kept.

d. Post Construction Changes. According to Mr. Dehner, Jr., no post construction changes have been made or have occurred which would affect the structural stability of the dam.

e. Seismic Stability. The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earthen dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicated that the spillway is capable of passing lake outflow of about 432 cfs without the level of the lake exceeding the low point in the top of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicates that for storm runoff of one-half probable maximum flood magnitude, the lake outflow would be about 529 cfs, and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 235 cfs. The existing spillway is inadequate to pass lake outflow resulting from a storm of one-half probable maximum flood magnitude (the recommended spillway design flood for this dam) and as a result of this inadequacy, overtopping of the dam is expected during this flood event. As indicated in Section 5, paragraph 5.1e, failure by erosion of the dam as a result of overtopping by the one-half probable maximum flood lake outflow is unlikely; however, it is a possibility.

Seepage and stability analyses of the dam were not available for review, and therefore, no judgment could be made with respect to the structural stability of the dam.

Several items were noticed during the inspection that could adversely affect the safety of the dam. These items include trees and dense undergrowth on the upstream and downstream slopes of the embankment, animal burrows, seepage, and the lack of adequate slope protection to prevent erosion of the upstream face of the dam.

b. Adequacy of Information. Due to lack of design and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessments of the hydrology of the watershed and capacity of the spillway were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The remedial measures recommended in paragraph 7.2 for the items concerning the safety of the dam noted in paragraph 7.1a should be accomplished within the near future.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. Seismic Stability. The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earthen dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended.

(1) Based upon criteria set forth in the recommended guidelines, spillway size and/or height of dam should be increased in order to pass lake outflow resulting from a storm of one-half probable maximum flood magnitude, the recommended spillway design flood for this dam.

(2) Obtain the necessary soil data and perform dam seepage and stability analyses in order to determine the structural stability of the dam for all operational conditions. Seepage and stability analyses should be performed by a qualified professional engineer experienced in the design and construction of earthen dams.

b. Operations and Maintenance (O & M) Procedures. The following O & M Procedures are recommended:

(1) Remove the trees and brush from the dam proper and the areas adjacent to the downstream toe of slope. The removal of trees should be performed under the direction and guidance of an engineer experienced in the

design and construction of earthen dams, since indiscriminate clearing can jeopardize the safety of the dam. The existing turf cover should be restored if destroyed or missing. Maintain the turf cover at a height that will not hinder inspection of the embankment or provide cover for burrowing animals. Holes from tree roots can provide a pathway for lake seepage that could lead to a piping condition (progressive internal erosion) and failure of the dam.

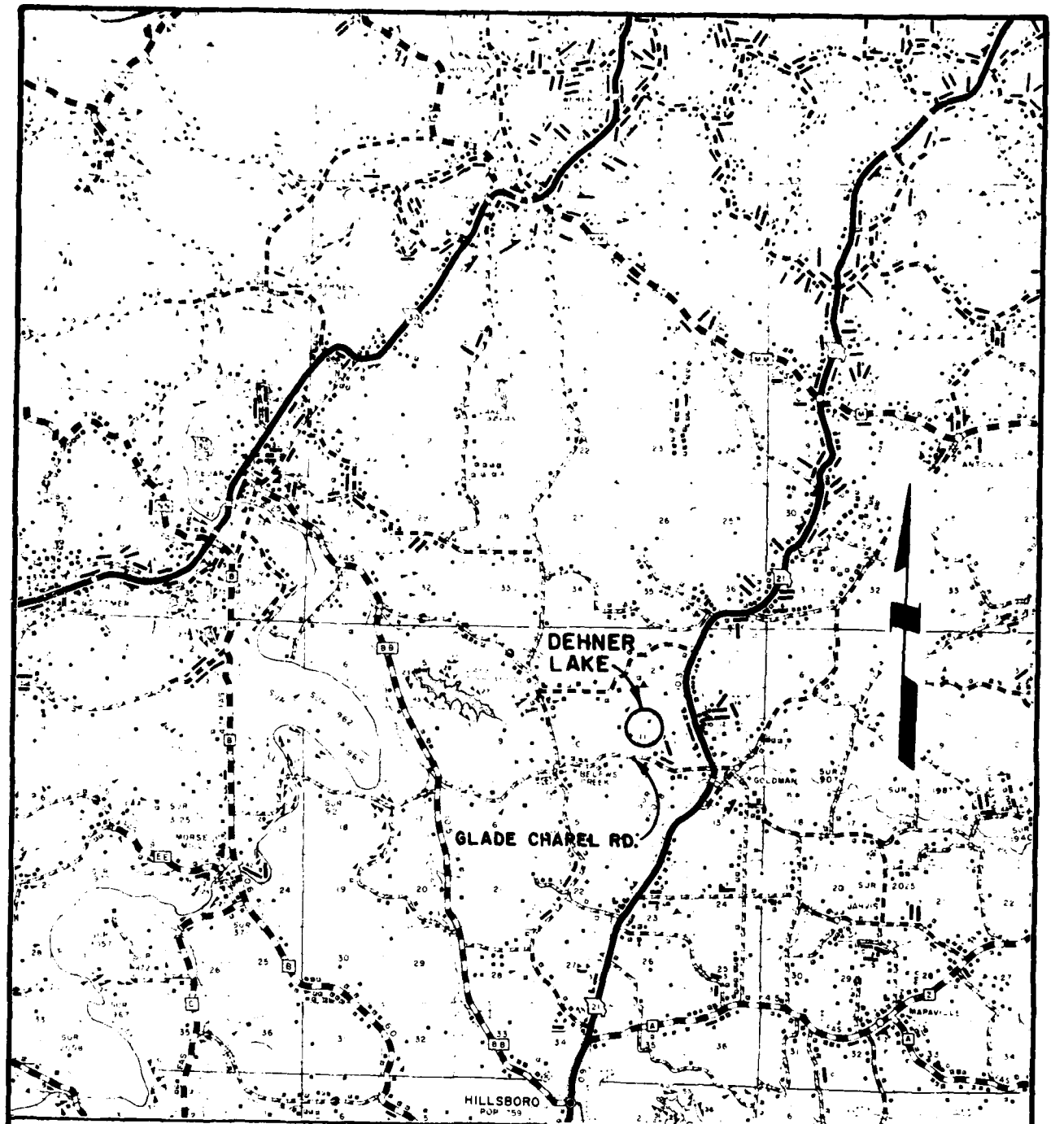
(2) Rid the dam of burrowing animals and restore the embankment to sound condition by filling holes with compacted impervious (clay) material. Animal burrows can provide passageways for lake seepage that could also result in a piping condition which, as previously stated, can lead to failure of the dam.

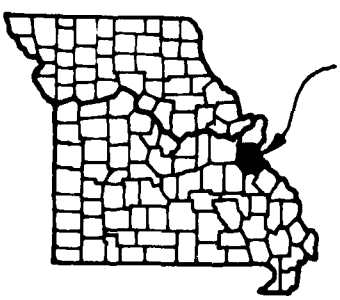
(3) Provide some means of controlling seepage evident in the area adjacent to the downstream toe near the center of the dam. Uncontrolled seepage can lead to a piping condition that can result in failure of the dam. Drainage of the areas affected by seepage including elimination of the wet area just downstream of the dam should be one of the objectives of the seepage control measures since saturation of the soil weakens the foundation which could impair the structural stability of the dam.

(4) Provide some form of protection other than grass for the upstream face of the dam at and above the normal waterline in order to prevent erosion by wave action or by a fluctuating lake level. A grass covered slope is not considered adequate protection to prevent erosion by wave action or by a fluctuating lake level. Erosion of the embankment can impair the structural stability of the dam.

(5) Provide maintenance of all areas of the dam and spillway on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

(6) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.





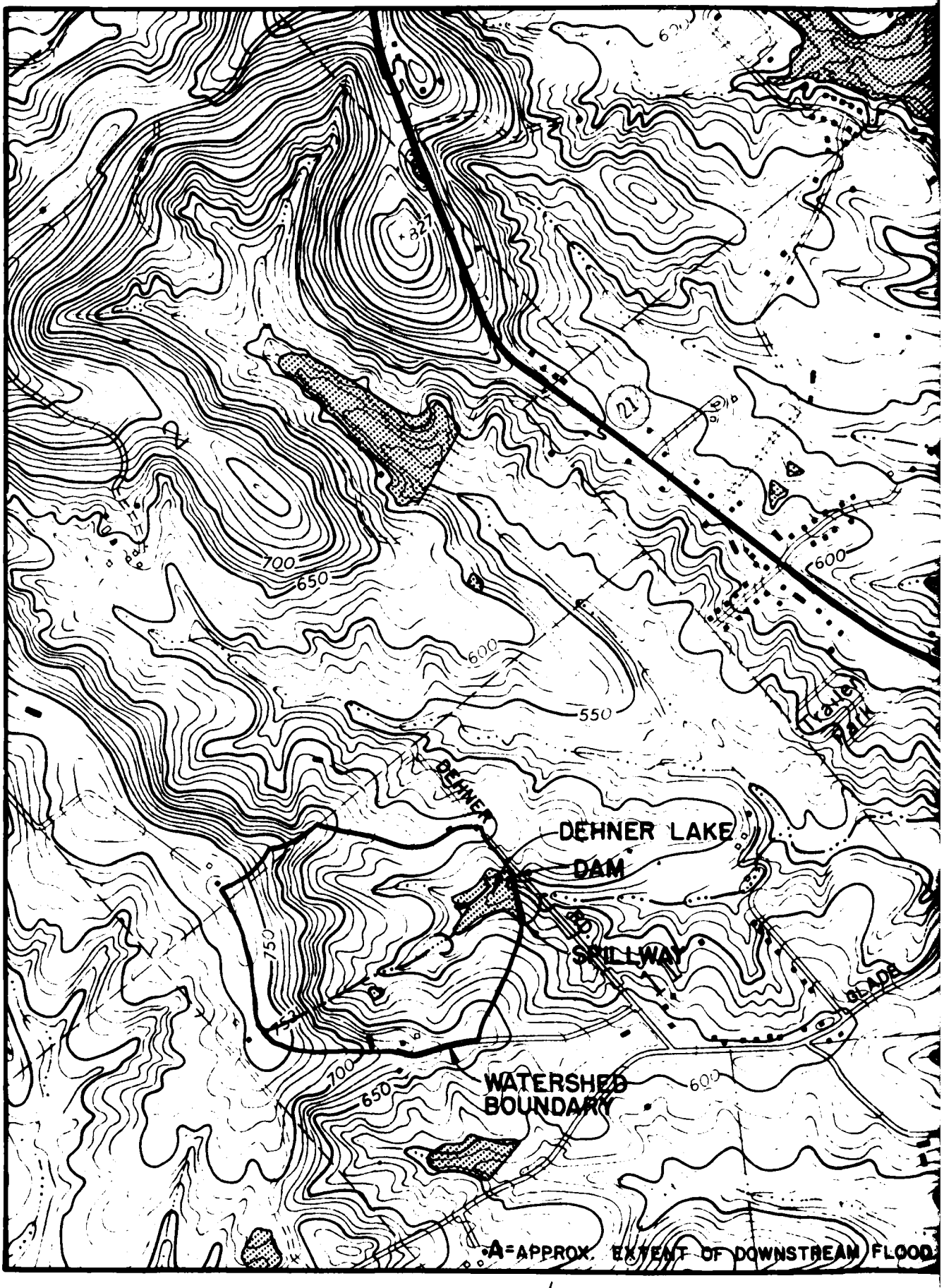
LOCATION MAP

DEHNER LAKE
DAM – MO 30423

0 1 2 3 4
SCALE (MILES)

REGIONAL VICINITY MAP

PLATE 1


DEHNER LAKE
DAM
SPILLWAY
WATERSHED
BOUNDARY
DEHNER
Trailer Park
BLADE
700
650
600
550
750
+827
21
A=APPROX. EXTENT OF DOWNSTREAM FLOOD

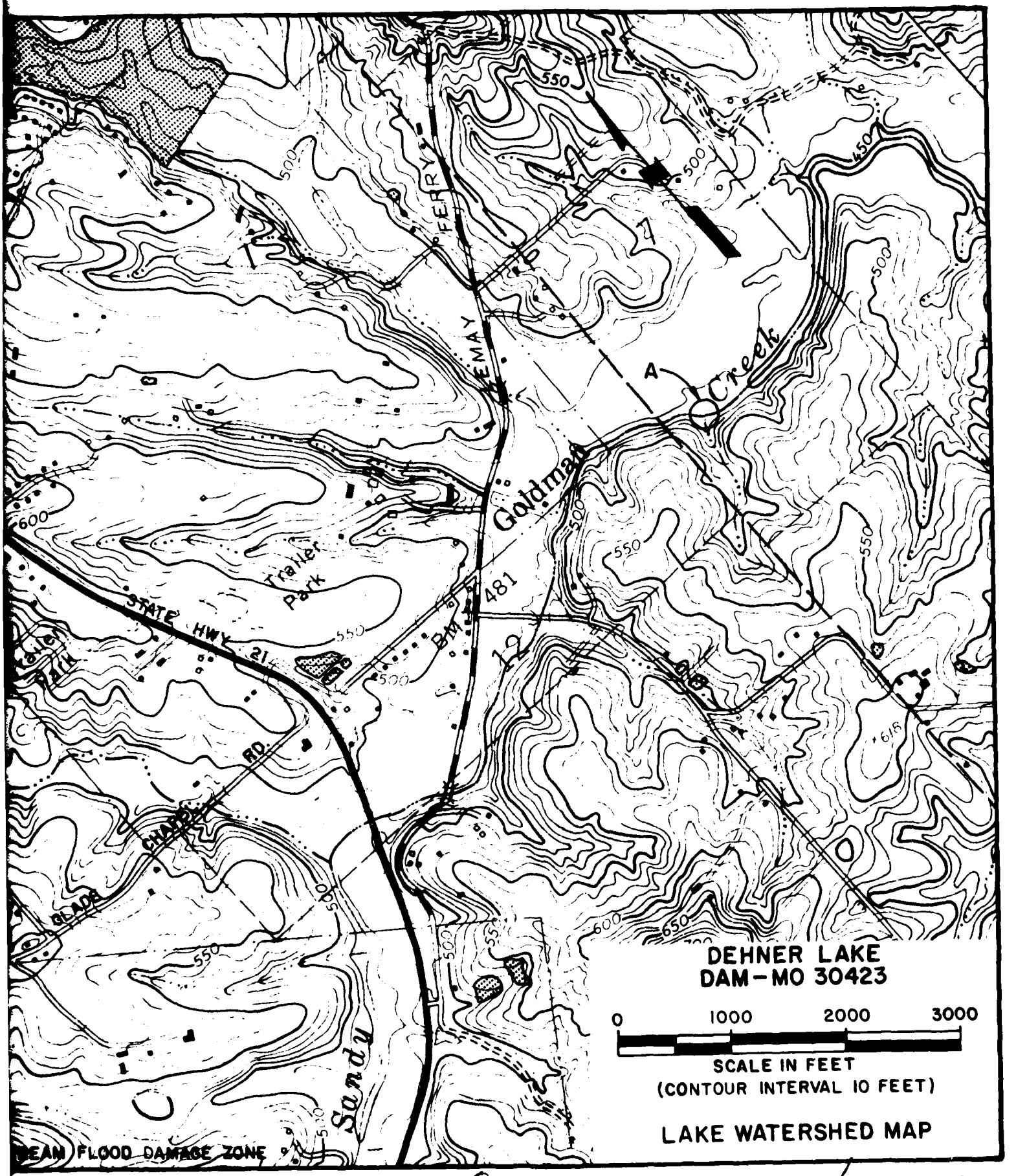
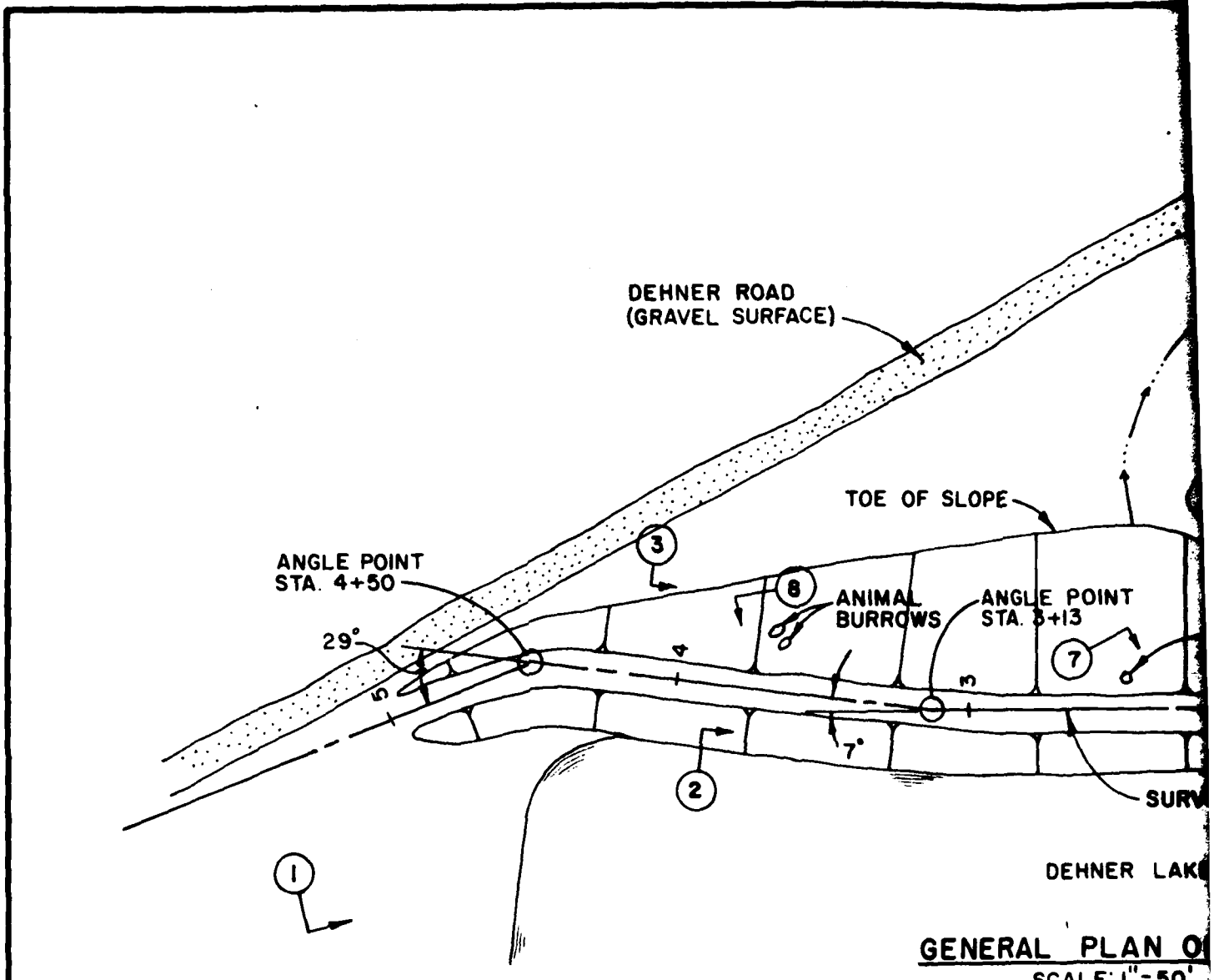
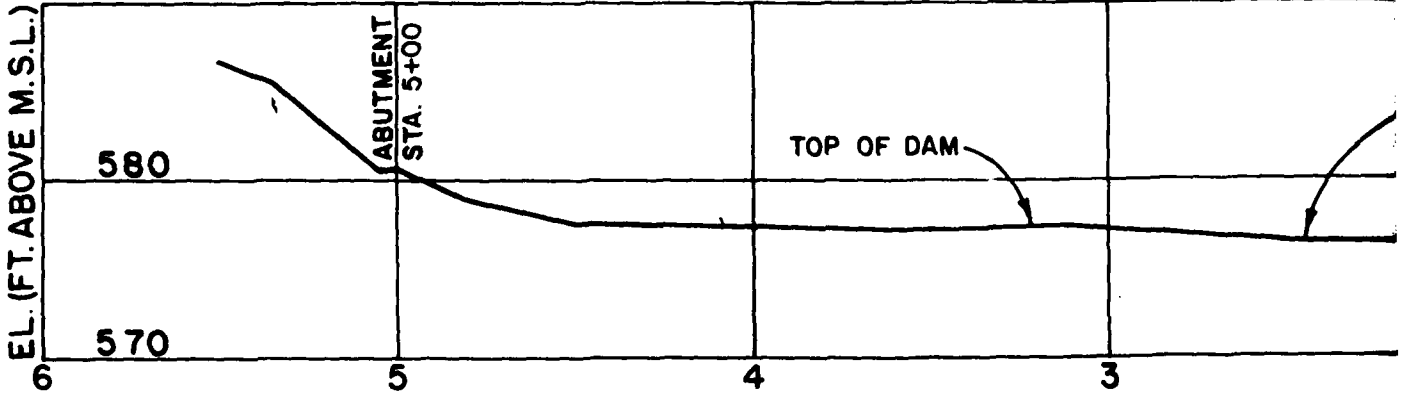

FERRY
FEMAY
Goldman
Creek
A
Trailer Park
STATE HWY 21
BM 481
RD.
CHAPEL
GLADE
Sandy
DEHNER LAKE
DAM - MO 30423
0 1000 2000 3000
SCALE IN FEET
(CONTOUR INTERVAL 10 FEET)
LAKE WATERSHED MAP
STREAM FLOOD DAMAGE ZONE

PLATE 2



GENERAL PLAN O

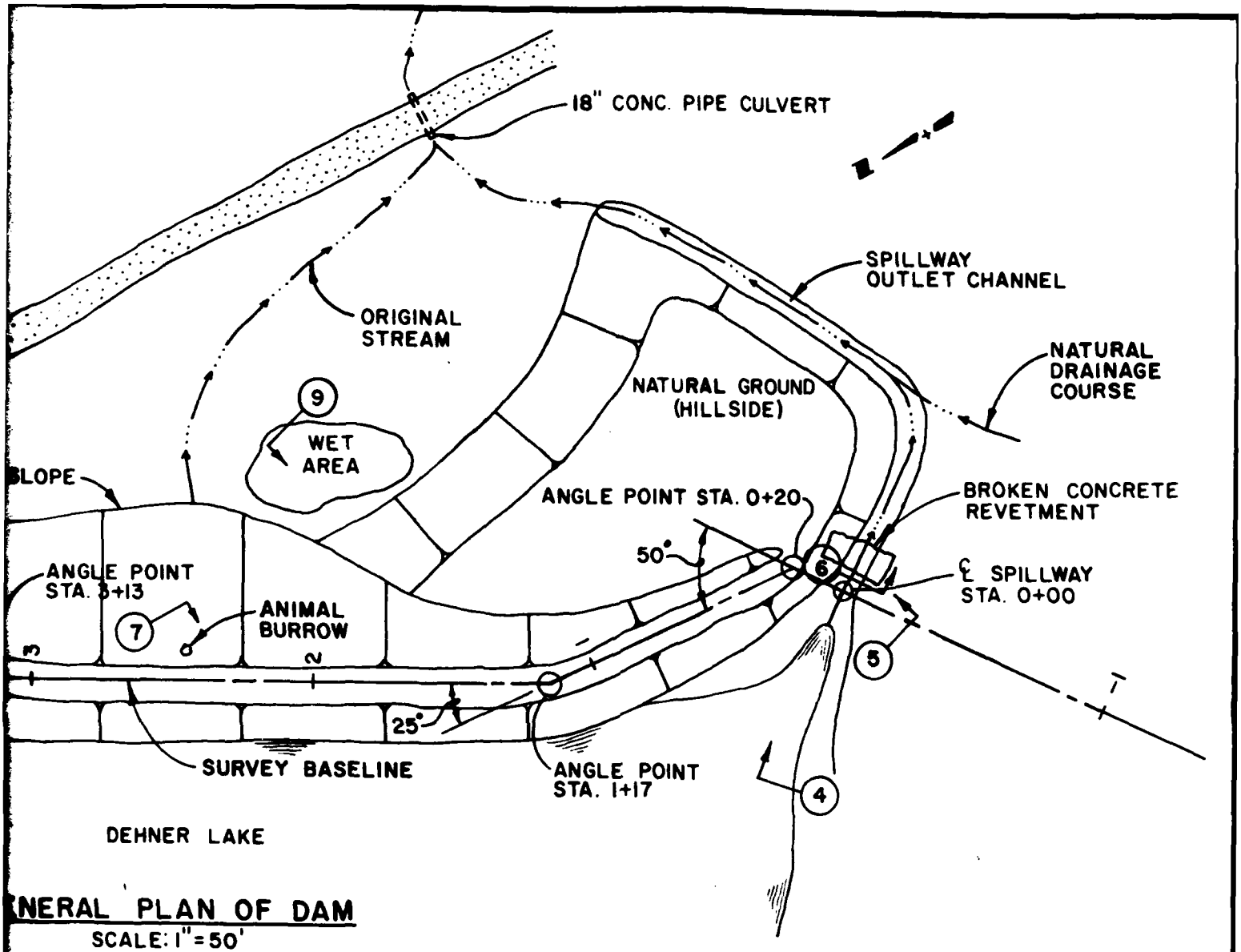
SCALE: 1" = 50'



PROFILE DAM C

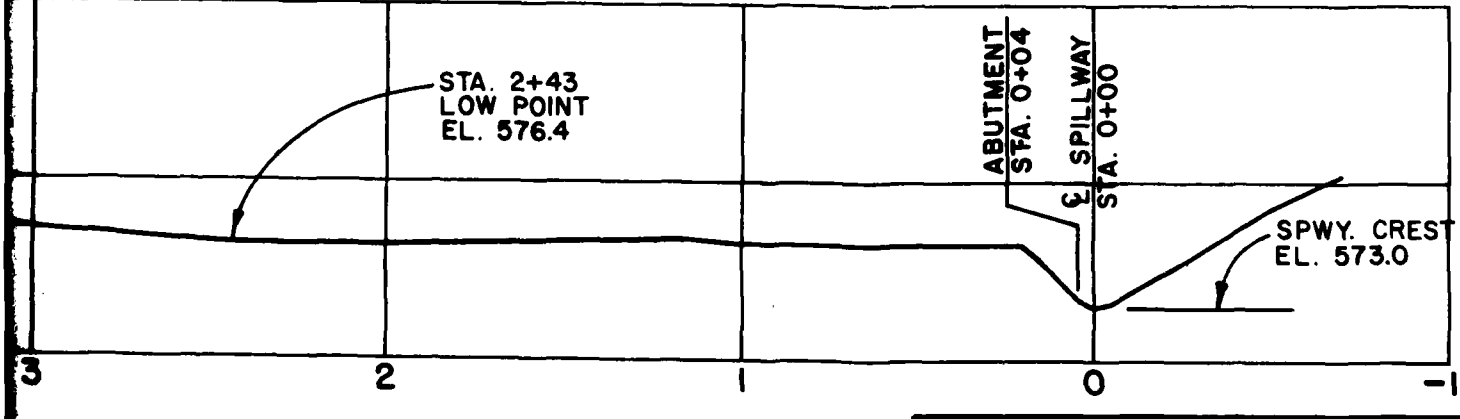
SCALES: 1" = 10' V., 1" = 5

PHOTO LOCATION & KEY
(SEE APPENDIX A)



GENERAL PLAN OF DAM

SCALE: 1" = 50'

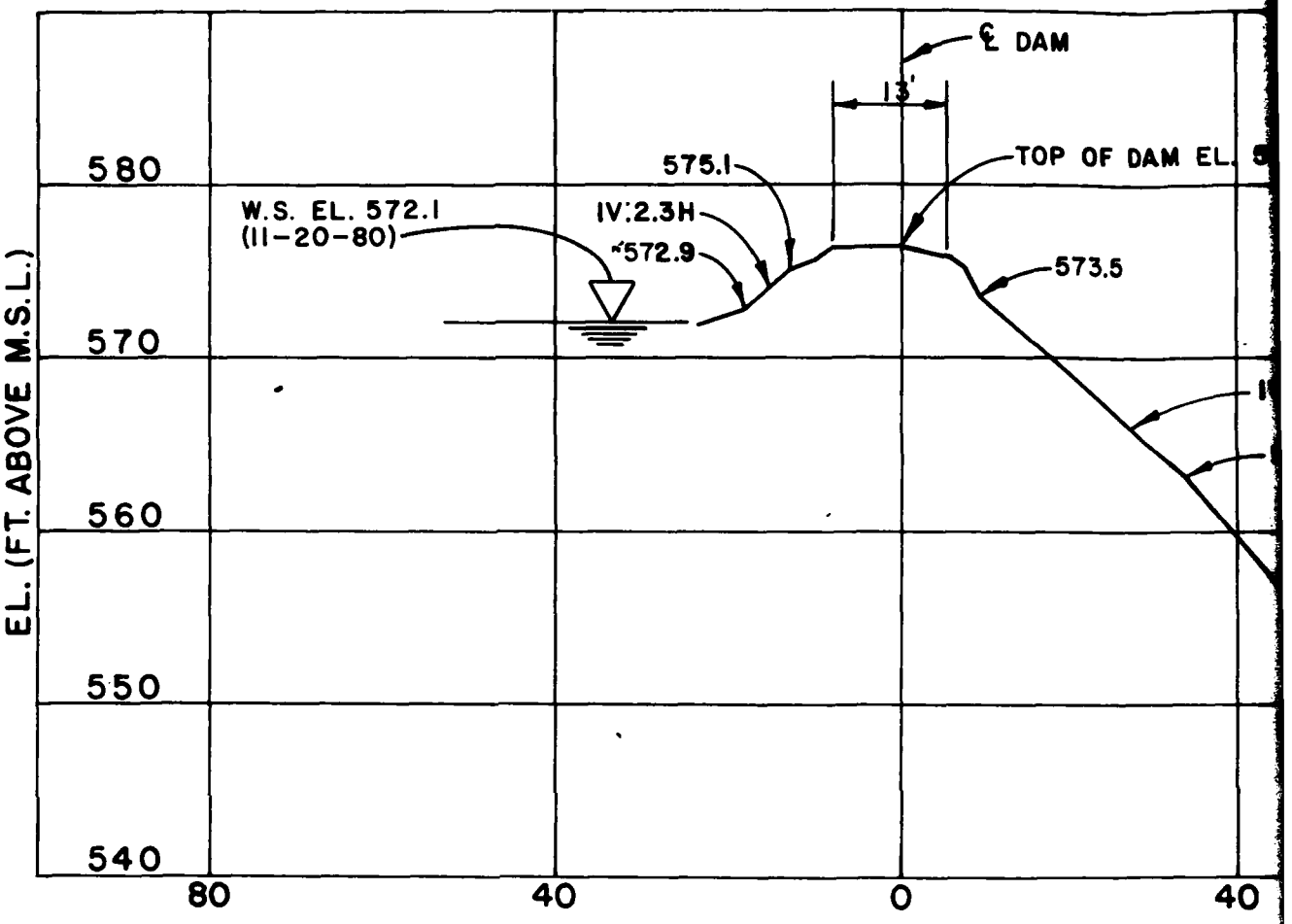


PROFILE DAM CREST

SCALES: 1" = 10' V., 1" = 50' H.

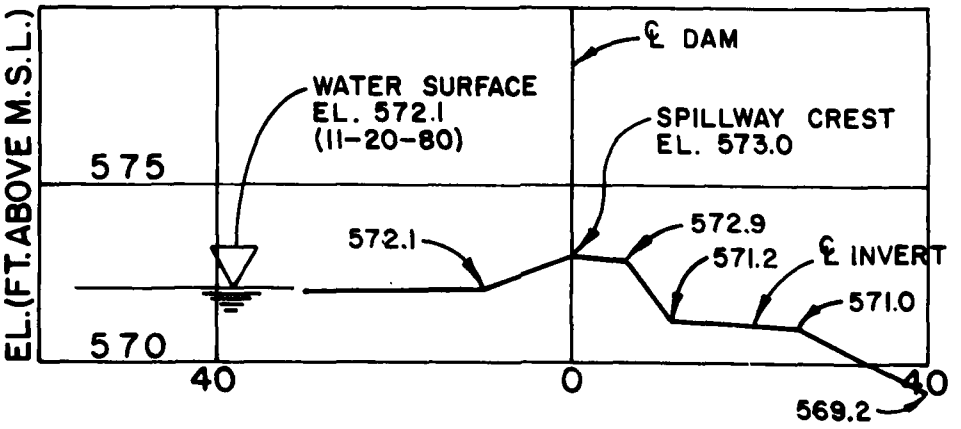
DEHNER LAKE
DAM PLAN & PROFILE
DAM - MO 30423

Horner & Shifrin, Inc. Jan., 1981



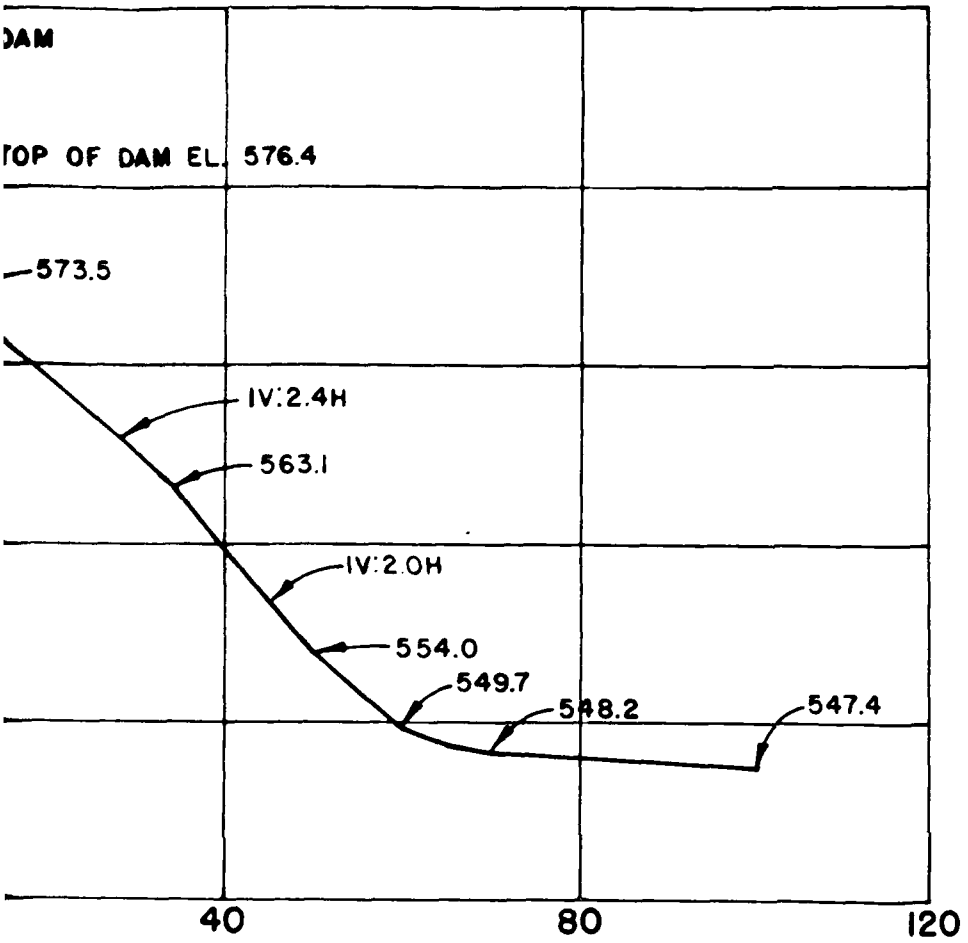
DAM CROSS-SECTION STA.

SCALES: 1"=10' V., 1"=20' H.

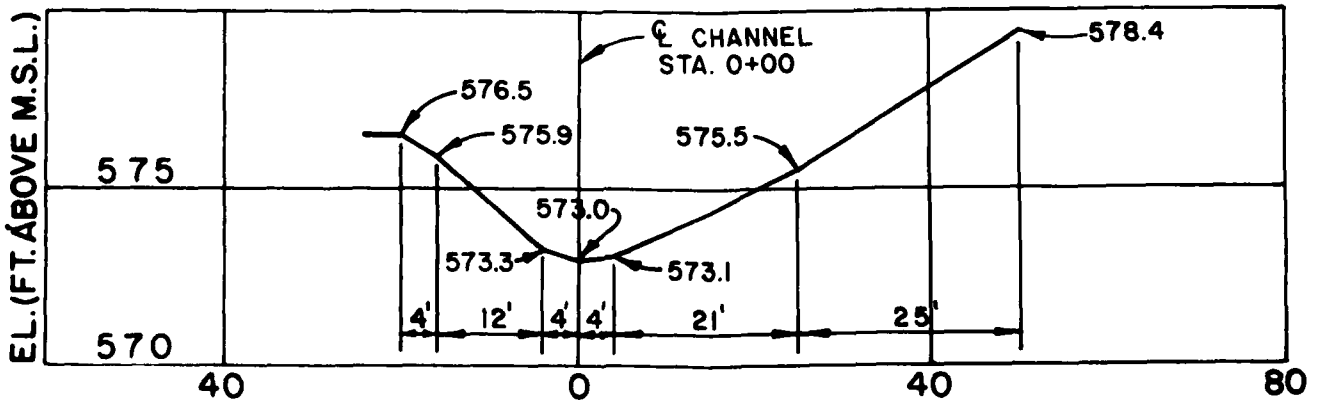


SPILLWAY PROFILE

SCALES: 1"=5' V., 1"=20' H.



SECTION STA. 2+43
1"=10' V., 1"=20' H.



SPILLWAY CROSS-SECTION
SCALES: 1"=5'V., 1"=20'H.

DAM-MO 30423

DEHNER LAKE
DAM CROSS-SECTION
SPILLWAY PROFILE & SECTION
Horner & Shifrin, Inc. Jan. 1981

APPENDIX A

INSPECTION PHOTOGRAPHS

1	2
3	

PHOTO KEY

NO.	DESCRIPTION
1	Dam Overview
2	Upstream Face of Dam
3	Downstream Face of Dam

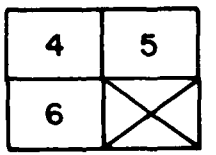


PHOTO KEY

NO.	DESCRIPTION
4	Spillway
5	Spillway Crest
6	Spillway Outlet Channel - Looking Downstream from Crest

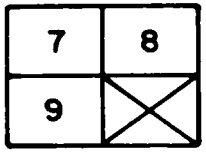


PHOTO KEY

NO.	DESCRIPTION
7	Animal Burrow - Sta. 2+43±
8	Animal Burrow - Sta. 3+68±
9	Seepage

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978, Modified 26 February 1979) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. miles, 24-hour value equals 25.5 inces) from Hydrometerological Report No. 33. The precipitation data used in the analysis of the 1 percent chance (100-year frequency) flood was provided by the St. Louis District, Corps of Engineers.

b. Storm duration = 24 hours, unit hydrograph duration = 5 minutes

c. Drainage area = 0.123 square miles = 79 acres.

d. SCS parameters:

Time of Concentration (Tc) = $(\frac{11.9L^3}{H})^{0.385}$ = 0.108 hours

Where: T_c = Travel time of water from hydraulically most distant point to point of interest, hours.

L = Length of longest watercourse = 0.360 miles.

H = Elevation difference = 198 feet.

The time of concentration (Tc) was obtained using method C as described in Fig. 30, "Design of Samll Dams", by the United States Department of the Interior, Bureau of Reclamation, and was verified using average channel velocity estimates and watercourse lengths.

Lag time = 0.062 hours (0.60 Tc)

Hydrologic Soil Group = 100% D (Gasconade Series with 2/3 wooded hillsides and 1/3 meadow per SCS Missouri General Soil Map and field inspection)

Soil type CN = 80 (AMC II, 100-yr flood)
= 91 (AMC III, PMF condition)

2. The spillway consists of a broad-crested trapezoidal section, for which conventional weir formulas do not apply.

Spillway release rates were determined as follows:

a. Spillway crest section properties (areas, "a", and top width, "t") were computed for various depths, "d".

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth Q_c was computed as $Q_c = (\frac{a^3 g}{t})^{0.5}$ for the various depths, "d". Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.* Reference "Handbook of Hydraulics", Fifth Edition, by King & Brater, page 8-7.

c. Static lake levels corresponding to the various flow values passing the spillway were computed as critical depths plus critical velocity heads ($d_c + H_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

d. The spillway discharges for corresponding elevations were entered on the Y4 and Y5 cards.

3. The profile of the dam crest is irregular and flow over the dam cannot be determined by application of conventional weir formulas. Crest length and elevation data for the dam crest proper were entered into the HEC-1 Program on the $L and $V cards. The program assumes that flow over the dam crest occurs at critical depth and computes internally the flow passing the dam crest and adds this flow to the flow passing the spillway as entered on the Y4 and Y5 cards.

* $v_c = \frac{Qc}{a}$; $Hvc = \frac{v_c^2}{2g}$

1 PERCENT CHANCE FLOOD (Cont'd)

01	.014	.014	.014	.014	.014	.014	.014	.014	.014	.014
01	.014	.014	.014	.014	.014	.014	.014	.014	.014	.014
01	.014	.014	.014	.014	.014	.014	.014	.014	.014	.014
01	.014	.014	.014	.014	.014	.014	.007	.007	[illegible]	[illegible]
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	[illegible]
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	[illegible]
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007		
T							1	.80		
W2		0.082								
X	-1.0	-.10	2.0							
K	1	DAM								
K1	RESERVOIR ROUTING BY MODIFIED PULS									
Y										
Y1	1						[illegible]			
Y4	[illegible]	[illegible]	[illegible]	576.22	576.71	577.40	[illegible]	[illegible]		
Y5	0	[illegible]	4.70	370.75	508.28	997.95	[illegible]	[illegible]		
$A	0	[illegible]	[illegible]	11.[illegible]	15.61					
$E	557	572	580	590	600					
$$	573.0									
$D	576.4									
$L	0	[illegible]	197	261	280	380	430	[illegible]	[illegible]	486
$V	576.4	576.3	576.7	576.9	577.2	577.4	577.8	[illegible]	[illegible]	580.7
K	99									

SUB-AREA RUNOFF COMPUTATION

B-6

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD Flow COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	[illegible]	.01	0.	[illegible]	12.05	145	.21	.21	.01	138.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.22	.21	.00	135.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.22	.21	.00	175.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.22	.21	.00	201.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.22	.21	.00	202.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.22	.21	.00	203.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.22	.21	.00	203.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.22	.21	.00	203.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.22	.21	.00	203.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.22	.21	.00	203.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.22	.21	.00	204.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.22	.21	.00	204.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.26	.26	.00	226.
[illegible]													

1.01	3.30	42	.01	.01	.01	6.	1.01	15.30	186	[illegible]	[illegible]	[illegible]	1160.
1.01	3.35	43	.01	.01	.01	7.	[illegible]	[illegible]	187	.77	.76	.01	2055.
1.01	3.40	44	.01	.01	.01	7.	1.01	15.40	[illegible]	1.07	1.07	[illegible]	1593.
1.01	3.45	45	.01	.01	.01	7.	1.01	15.45	189	.69	.59	.03	972.
1.01	3.50	46	.01	.01	.01	7.	1.01	15.50	190	.57	.59	.00	690.
1.01	3.55	47	.01	.01	.01	7.	1.01	15.55	191	.40	.37	.03	493.
1.01	4.00	48	.01	.01	.01	7.	1.01	[illegible]	192	.40	[illegible]	[illegible]	405.
1.01	4.05	49	.01	.01	.01	7.	1.01	[illegible]	193	.30	[illegible]	[illegible]	334.
1.01	4.10	50	.01	.01	.01	7.	1.01	16.10	[illegible]	.20	.06	[illegible]	[illegible]
1.01	[illegible]	51	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	291.
1.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.01	[illegible]	[illegible]	[illegible]	[illegible]	.01	8.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.01	4.40	[illegible]	[illegible]	[illegible]	[illegible]	8.	1.01	[illegible]	[illegible]	.30	[illegible]	[illegible]	[illegible]
1.01	4.45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.01	[illegible]	[illegible]	[illegible]	.01	[illegible]	8.	1.01	[illegible]	[illegible]	.30	[illegible]	[illegible]	289.
1.01	4.55	[illegible]	[illegible]	.01	.01	8.	[illegible]	[illegible]	[illegible]	.30	[illegible]	[illegible]	269.
1.01	5.00	[illegible]	[illegible]	[illegible]	[illegible]	8.	1.01	17.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.01	5.05	[illegible]	[illegible]	[illegible]	.01	9.	1.01	17.05	205	.24	.24	[illegible]	254.
1.01	5.10	[illegible]	[illegible]	[illegible]	.01	9.	1.01	17.10	206	.24	.24	.00	234.
1.01	5.15	[illegible]	[illegible]	[illegible]	.00	9.	1.01	17.15	207	.24	.24	.00	[illegible]
1.01	5.20	64	.01	[illegible]	.00	9.	1.01	17.20	208	.24	.24	[illegible]	[illegible]
1.01	5.25	65	.01	.01	.00	9.	1.01	17.25	[illegible]	.24	.24	[illegible]	[illegible]
1.01	5.30	66	.01	.01	.00	9.	1.01	17.30	210	.24	.24	[illegible]	[illegible]
1.01	5.35	67	.01	.01	.00	9.	1.01	17.35	211	.24	.24	.00	227.
1.01	5.40	68	.01	.01	.00	9.	1.01	17.40	212	.24	.24	.00	227.
1.01	5.45	69	.01	.01	.00	9.	1.01	17.45	213	.24	.24	.00	227.
1.01	5.50	70	.01	.01	.00	9.	1.01	17.50	214	.24	.24	[illegible]	227.
1.01	5.55	71	.01	.01	.00	9.	1.01	17.55	215	.24	.24	.00	227.
1.01	6.00	72	.01	.01	.00	9.	1.01	18.00	216	.24	.24	.00	227.
1.01	6.05	73	.06	.05	.02	28.	1.01	18.05	217	.02	.02	.00	194.
1.01	6.10	74	.06	.05	.02	40.	1.01	18.10	218	.02	.02	.00	181.
1.01	6.15	75	.06	.05	.02	44.	1.01	18.15	219	.02	.02	.00	169.
1.01	6.20	76	.06	.05	.02	46.	1.01	18.20	220	.02	.02	.00	158.
1.01	6.25	77	.06	.05	.01	47.	1.01	18.25	221	[illegible]	[illegible]	[illegible]	147.
1.01	6.30	78	.06	.05	.01	47.	1.01	18.30	222	[illegible]	[illegible]	[illegible]	137.
1.01	6.35	79	.06	.05	.01	48.	1.01	18.35	223	[illegible]	.02	[illegible]	128.
1.01	6.40	80	.06	.05	.01	49.	1.01	18.40	224	[illegible]	.02	.00	120.
1.01	6.45	81	.06	.05	.01	50.	1.01	18.45	225	[illegible]	[illegible]	.00	112.
1.01	6.50	82	.06	.05	.01	50.	1.01	18.5	226	[illegible]	[illegible]	[illegible]	104.
1.01	6.55	83	.06	.05	.01	51.	1.01	18.55	227	[illegible]	[illegible]	[illegible]	97.
1.01	[illegible]	[illegible]	[illegible]	.05	.01	51.	1.01	19.00	[illegible]	[illegible]	[illegible]	[illegible]	91.
1.01	7.05	85	[illegible]	.05	.01	52.	1.01	19.05	[illegible]	[illegible]	[illegible]	[illegible]	85.
1.01	7.10	86	[illegible]	[illegible]	.01	52.	[illegible]	19.10	[illegible]	[illegible]	[illegible]	[illegible]	79.
1.01	7.15	87	[illegible]	[illegible]	[illegible]	53.	[illegible]	[illegible]	231	[illegible]	.02	[illegible]	74.
1.01	7.20	88	[illegible]	[illegible]	.01	53.	[illegible]	[illegible]	[illegible]	.02	.02	[illegible]	69.
1.01	7.25	89	.06	[illegible]	.01	53.	1.01	[illegible]	233	[illegible]	[illegible]	.00	64.
1.01	[illegible]	[illegible]	.06	.06	.01	54.	1.01	[illegible]	234	[illegible]	.02	[illegible]	60.
1.01	7.35	[illegible]	[illegible]	[illegible]	.01	54.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56.
[illegible]	7.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	52.
[illegible]	7.45	93	[illegible]	[illegible]	[illegible]	54.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	48.
1.01	[illegible]	94	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45.
1.01	[illegible]	95	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	42.
1.01	[illegible]	[illegible]	.06	[illegible]	.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	39.
1.01	[illegible]	97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37.
1.01	[illegible]	[illegible]	.06	.06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34.

END-OF-PERIOD FLOW (Cont'd)

1.01	8.15	99	.06	.05	.01	56.	1.01	20.40	251	.02	.02	.00	22.
1.01	8.20	100	.06	.05	.00	56.	1.01	20.45	252	.02	.02	.00	30.
1.01	8.25	101	.06	.06	.00	58.	1.01	20.50	253	.02	.02	.00	28.
1.01	8.30	102	.06	.06	.00	58.	1.01	20.55	254	.02	.02	.00	26.
1.01	8.35	103	.06	.06	.00	58.	1.01	21.00	255	.02	.02	.00	24.
1.01	8.40	104	.06	.06	.00	57.	1.01	21.05	256	.02	.02	.00	23.
1.01	8.45	105	.06	.06	.00	57.	1.01	21.10	257	.02	.02	.00	21.
1.01	8.50	106	.06	.06	.00	57.	1.01	21.15	258	.02	.02	.00	20.
1.01	8.55	107	.06	.06	.00	57.	1.01	21.20	259	.02	.02	.00	20.
1.01	9.00	108	.06	.06	.00	57.	1.01	21.25	260	.02	.02	.00	20.
1.01	9.05	109	.06	.06	.00	57.	1.01	21.30	261	.02	.02	.00	20.
1.01	9.10	110	.06	.06	.00	57.	1.01	21.35	262	.02	.02	.00	20.
1.01	9.15	111	.06	.06	.00	57.	1.01	21.40	263	.02	.02	.00	20.
1.01	9.20	112	.06	.06	.00	58.	1.01	21.45	264	.02	.02	.00	20.
1.01	9.25	113	.06	.06	.00	58.	1.01	21.50	265	.02	.02	.00	20.
1.01	9.30	114	.06	.06	.00	58.	1.01	21.55	266	.02	.02	.00	20.
1.01	9.35	115	.06	.06	.00	58.	1.01	22.00	267	.02	.02	.00	20.
1.01	9.40	116	.06	.06	.00	58.	1.01	22.05	268	.02	.02	.00	20.
1.01	9.45	117	.06	.06	.00	58.	1.01	22.10	269	.02	.02	.00	20.
1.01	9.50	118	.06	.06	.00	58.	1.01	22.15	270	.02	.02	.00	20.
1.01	9.55	119	.06	.06	.00	58.	1.01	22.20	271	.02	.02	.00	20.
1.01	10.00	120	.06	.06	.00	58.	1.01	22.25	272	.02	.02	.00	20.
1.01	10.05	121	.06	.06	.00	58.	1.01	22.30	273	.02	.02	.00	20.
1.01	10.10	122	.06	.06	.00	58.	1.01	22.35	274	.02	.02	.00	20.
1.01	10.15	123	.06	.06	.00	58.	1.01	22.40	275	.02	.02	.00	20.
1.01	10.20	124	.06	.06	.00	58.	1.01	22.45	276	.02	.02	.00	20.
1.01	10.25	125	.06	.06	.00	58.	1.01	22.50	277	.02	.02	.00	20.
1.01	10.30	126	.06	.06	.00	59.	1.01	22.55	278	.02	.02	.00	20.
1.01	10.35	127	.06	.06	.00	59.	1.01	23.00	279	.02	.02	.00	20.
1.01	10.40	128	.06	.06	.00	59.	1.01	23.05	280	.02	.02	.00	20.
1.01	10.45	129	.06	.06	.00	59.	1.01	23.10	281	.02	.02	.00	20.
1.01	10.50	130	.06	.06	.00	59.	1.01	23.15	282	.02	.02	.00	20.
1.01	10.55	131	.06	.06	.00	59.	1.01	23.20	283	.02	.02	.00	20.
1.01	11.00	132	.06	.06	.00	59.	1.01	23.25	284	.02	.02	.00	20.
1.01	11.05	133	.06	.06	.00	59.	1.01	23.30	285	.02	.02	.00	20.
1.01	11.10	134	.06	.06	.00	59.	1.01	23.35	286	.02	.02	.00	20.
1.01	11.15	135	.06	.06	.00	59.	1.01	23.40	287	.02	.02	.00	20.
1.01	11.20	136	.06	.06	.00	57.	1.01	23.45	288	.02	.02	.00	20.
1.01	11.25	137	.06	.06	.00	58.	1.01	23.50	289	.02	.02	.00	20.
1.01	11.30	138	.06	.06	.00	59.	1.01	23.55	290	.02	.02	.00	20.
1.01	11.35	139	.06	.06	.00	59.	1.01	24.00	291	.02	.02	.00	20.
1.01	11.40	140	.06	.06	.00	59.	1.01	24.05	292	.02	.02	.00	20.
1.01	11.45	141	.06	.06	.00	59.	1.01	24.10	293	.02	.02	.00	20.
1.01	11.50	142	.06	.06	.00	59.	1.01	24.15	294	.02	.02	.00	20.
1.01	11.55	143	.06	.06	.00	59.	1.01	24.20	295	.02	.02	.00	20.
1.01	12.00	144	.06	.06	.00	59.	1.01	24.25	296	.02	.02	.00	20.
											6.9	38.15	31.6	1.18	4256.
															13.3

[illegible]	0.	3.	7.	11.	16.
[illegible]	0.	25.	65.	154.	281.
ELEVATION	560.	570.	580.	590.	600.

SUMMARY OF DAM [illegible] ANALYSIS

PMF

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	575.00	578.00	596.40
STORAGE	0.	37.	427.
OUTFLOW	0.	0.	0.

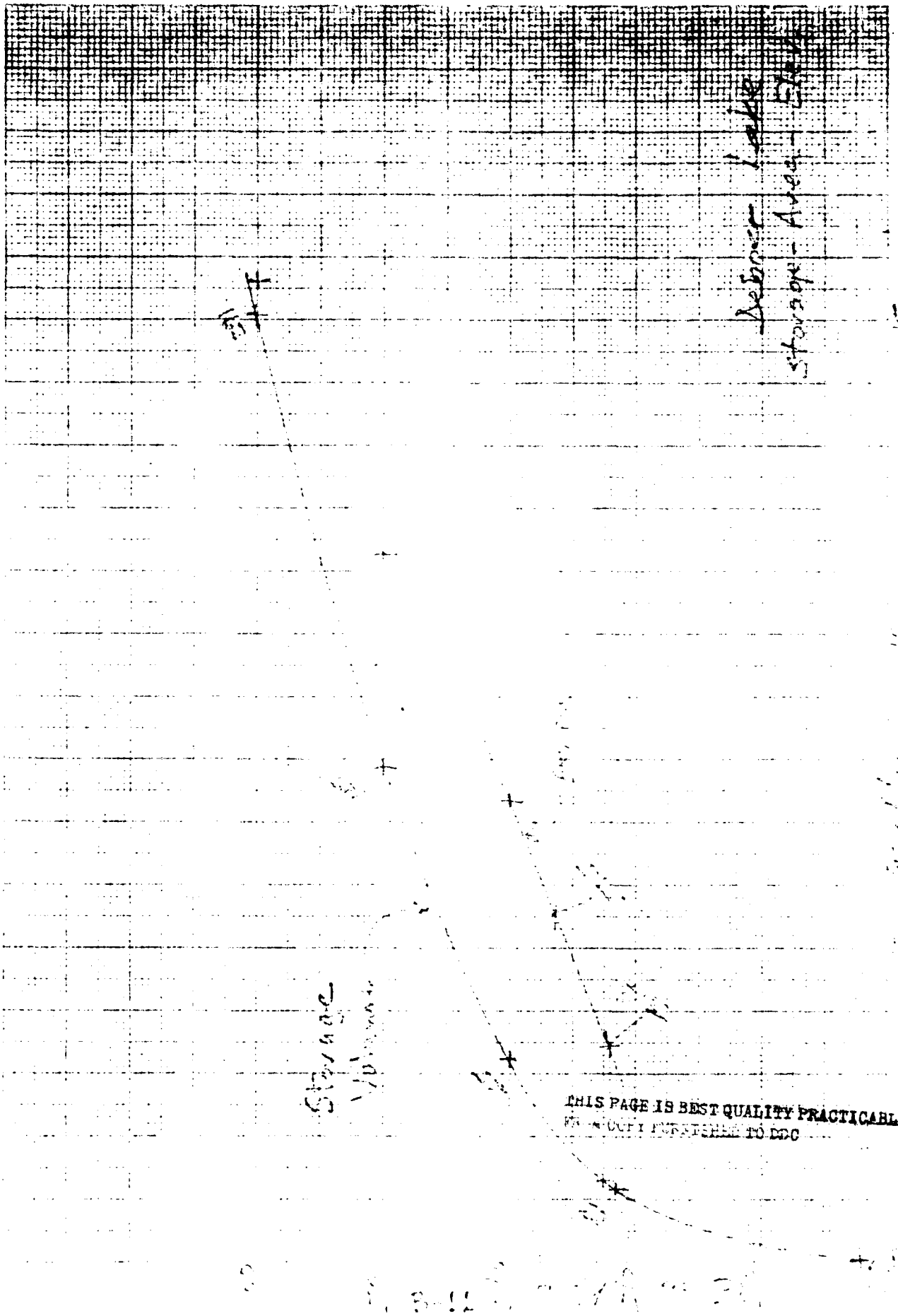
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM STORAGE (AC-FT)	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	575.09	0.00	34.	235.	0.00	12.25	0.00

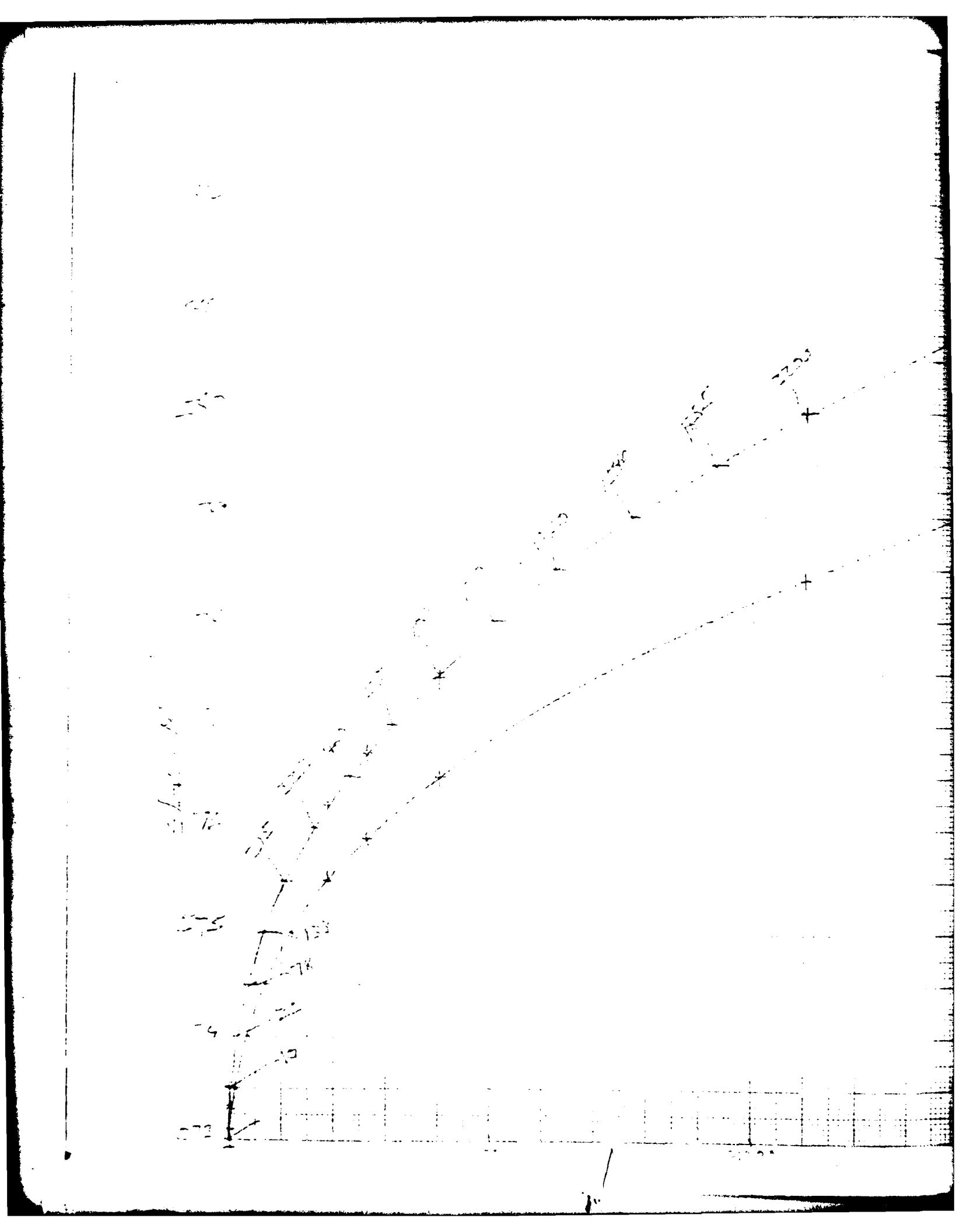
SUMMARY OF DAM [illegible] ANALYSIS

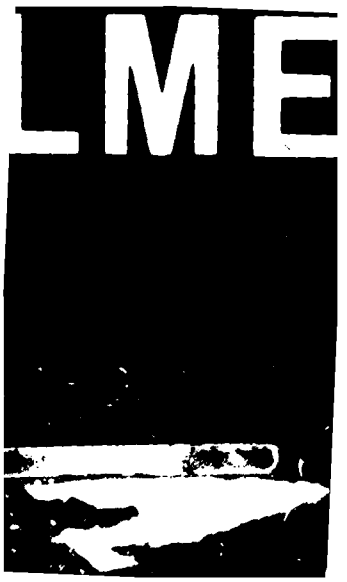
1% CHANCE FLOOD

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	575.00	578.00	[illegible]
STORAGE	0.	37.	[illegible]
OUTFLOW	0.	0.	[illegible]

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM STORAGE (AC-FT)	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	575.09	0.00	34.	235.	0.00	12.25	0.00






LME